Soyuz 7 Return Samples: Assessment of Air Quality Aboard the International Space Station

The toxicological assessments of one grab sample canister (GSC), 6 dual sorbent tubes (DSTs), and 20 formaldehyde badges returned aboard Soyuz 7 are reported. Analytical methods have not changed from earlier reports. Surrogate standard recoveries from the GSC were 84-89%. The recoveries of the less volatile surrogates from the DSTs were 87 to 112%; however, ^{13}C-acetone was only recovered at 53-59%. Formaldehyde recoveries from 2 lab controls were 87 and 95%; trip controls were not returned to ground.

The two general criteria used to assess air quality are the total-non-methane-volatile organic hydrocarbons (NMVOCs) and the total T-value (minus the CO_2 and formaldehyde contributions). Control of atmospheric alcohols is important to the water recovery system engineers, hence total alcohols (including acetone) are also shown for each sample. Because formaldehyde is quantified from sorbent badges, its concentration is also listed separately. These four indices of air quality are summarized below:

Sample & Location	Date	NMVOCs (mg/m^3)	T Value[a] (units)	Alcohols (mg/m^3)	Formaldehyde ($\mu g/m^3$)
Lab/For.	12/15/03	ns[b]	ns	ns	40
SM/For.	12/15/03	ns	ns	ns	30
Lab/For.	12/29/03	ns	ns	ns	46
SM/For.	12/29/03	ns	ns	ns	40
Lab/For.	1/27/04	ns	ns	ns	44
SM/For.	1/27/04	ns	ns	ns	34
Lab DST	3/3/04	7	0.87	4	ns
SM DST	3/3/04	8	0.91	5	ns
SM GSC	3/18/04[c]	11	0.61	6	ns
SM DST	3/18/04[c]	10	0.91	7	ns
Lab DST/For	3/22/04	9	0.89	6	50
SM/For	3/22/04	ns	---	---	44
Lab DST/For	4/19/04	9	0.75	7	42
SM DST/For.	4/19/04	10	0.91	7	30
Acceptable Guideline:		*<25*	*<1*	*<5*	*50*

[a] Formaldehyde and CO2 not included in T calculation.
[b] ns = no sample available
[c] Taken 4-6 days after problems with the Elektron oxygen generator

All formaldehyde concentrations were within the long term SMAC. The Lab samples continue to show somewhat higher values than the SM samples. The T values and NMVOCs are within acceptable guidelines; however, the total alcohol levels slightly exceed the guideline of 5 mg/m^3. The GSC sample taken several days after the Elektron anomaly showed above nominal concentrations of aromatic compounds (when compared to analyses from recent flights) as follows: toluene, 0.12 mg/m^3; xylenes, 0.30 mg/m^3; and ethylbenzene, 0.14 mg/m^3. Simultaneous sampling with the DST gave concentrations about 13-20 % below these values. Although the air samples are sparse, there are no indications that air quality has degraded in the ISS. For all but the most volatile compounds, the DSTs provide adequate air samples in a much smaller package than the GSCs.

Enclosures

Table 1: Analytical Concentrations of DST and GSC Samples
Table 2: T-Value Calculations of DST and GSC Samples